dislocation.

Though the repetition number of two or more kinds of epitaxial crystal layers having different compositions in the buffer layer is two in the embodiment of Fig. 1, it is preferable that the repetition number is larger, since an effect of suppressing propagation of dislocation in the GaAs substrate into an upper layer is higher when this repetition number is larger. Judging from experiments, though a repetition number of one gives a sufficient effect, the repetition number may be appropriately selected in a range from 1 to 30, preferably from 2 to 20 so as to give desired dislocation density.

The epitaxial crystal layers having different compositions in the buffer layer can be allowed to grow alternately to have given thickness on the GaAs substrate, and by this, the buffer layer having a superlattice structure can be formed. The thickness of the layer is not especially limited, and can be appropriately selected in a range from 0.5 nm to 500 nm, preferably from 5 nm to 50 nm. They may have different layer thicknesses.

In this embodiment, by doping an n-type dopant into at least one layer constituting the buffer layer, propagation of dislocation from the GaAs layer into an upper layer can be suppressed more effectively as compared with a case of no doping. As the n-type dopant, Si, Ge, Sn and Pb are exemplified, and among them, Si is preferable.

The doping concentration of n-type dopant is not restricted especially, and can be appropriately selected in a range from 1×10^{17} cm^{-3} to 1×10^{19} cm^{-3} to attain a desired effect. The doping concentration is preferably 1×10^{17} cm^{-3} to 5×10^{18} cm^{-3}, and more referably 5×10^{17} cm^{-3} to 5×10^{18} cm^{-3}. Thus, when an n-type dopant is doped into any one layer constituting the buffer layer, having a superlattice structure, dislocation can be terminated due to an effect of disturbance in a crystal potential field around the n-type dopant atom, consequently, propagation of dislocation toward an upper layer from the GaAs substrate can be more effectively suppressed.

Doping is conducted uniformly into a layer constituting a buffer layer as above, however, as the additional method, so-called planar-doping can be effected, in which doping is conducted only on a specific plane in the layer, to obtain the same effect. The position of a plane on which planar-doping is effected may be inside of the layers or at the interface of two kinds of layers. At any position, the concentration of planar-doping is effectively and preferably 1×10^{11} cm^{-2} or more and 5×10^{12} cm^{-2} or less.

Thus, when the buffer layer is grown on the GaAs substrate, propagation of dislocation through the buffer layer is suppressed, consequently, the dislocation density in the optical device layer grown on the buffer layer can be decreased irrespective of the dislocation density of the GaAs substrate.

As a result, the probability of occurrence of element deterioration can be reduced, and a problem of shortening of element life due to gradual progress of crystal defects with the lapse of time, in the optical device layer, can be solved. Further, since crystal lattice defects can be reduced, irradiative recombination decreases, and the light-emitting efficiency increases. Therefore, when light-emitting devices such as LED, laser diode and the like are made based on this constitution, a high performance optical device having longer life and higher reliability can be provided.

For enabling confirmation of reduction of dislocation density by provision of the above-mentioned buffer layer, an optical device layer of known constitution for measuring PL is formed.

Several methods for measurement of dislocation density are known in the prior art.

Transmission electron microscope (TEM) method is useful for the measurement, and permits the direct observation and even the characterization of dislocations. Nevertheless, the method has problems such as a narrow field of view, a destructive test, the necessity of skill and time in sample preparation, and a difficulty in observing the samples of low dislocation density.

X-ray topography method is also useful for the measurement, and similarly permits the direct observation and even the